Combined Heat and Power

Identifying Opportunities and Streamlining the Project Development Process

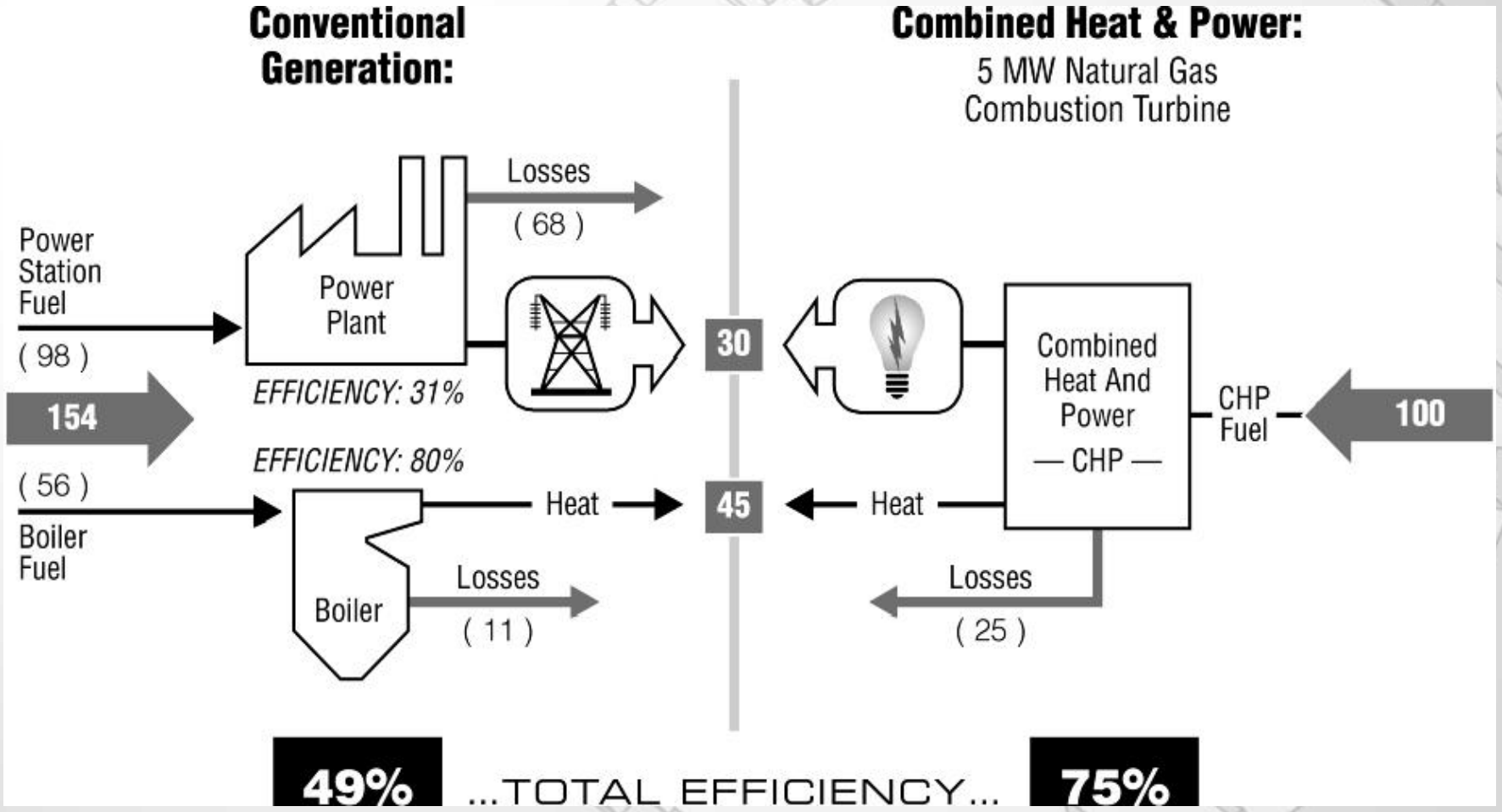
Kim Crossman
US EPA CHP Partnership
Energy 2005 Workshop – Secure Your Energy Future
August 16, 2005

Combined Heat and Power (CHP) defined:

- The simultaneous production and usage of at least two forms of usable energy from the combustion of one fuel.
  - Fuels: natural gas, biomass, biogas, coal, waste heat
  - Outputs: electricity, shaft power, hot water, steam, chilled water, dehumidification
- A proven, highly efficient alternative to separate power and heat production.
- ~ 80,000 MW of existing CHP in US

CHP
EPA COMBINED HEAT AND POWER PARTNERSHIP

Efficiency Advantages of CHP



CHP
EPA COMBINED HEAT AND POWER PARTNERSHIP

The Benefits of CHP

- Environment: reduces GHG emissions
- Economic: reduces energy costs
- Reliability: decreases impact of power outages
- Security: increases national energy security

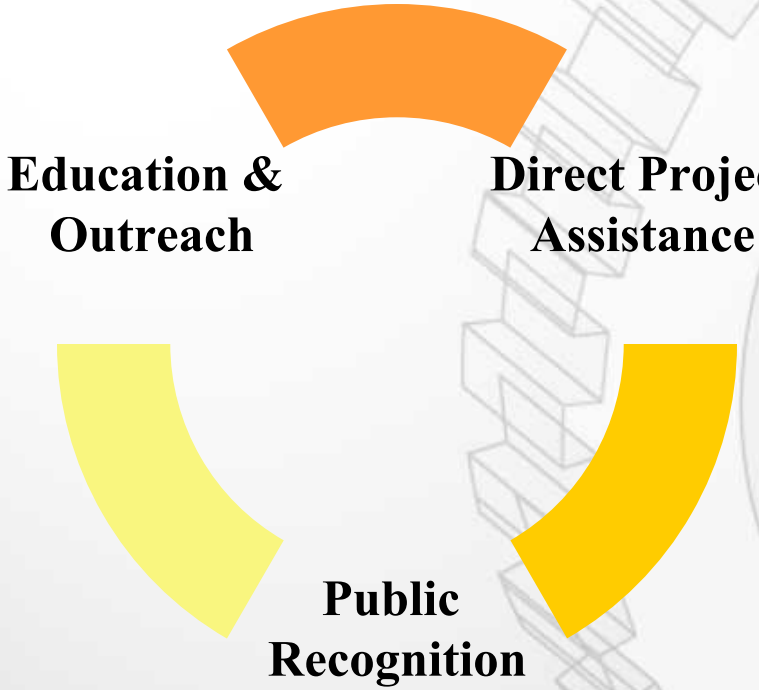
CHP
EPA COMBINED HEAT AND POWER PARTNERSHIP

EPA & Combined Heat and Power

- The EPA CHP Partnership is a voluntary program that seeks to reduce the environmental impact of power generation by fostering the use of highly-efficient CHP
- In the past 4 years, the CHPP has helped Partners put into operation more than 110 CHP projects representing 2,250 MW of capacity.

CHP
EPA COMBINED HEAT AND POWER PARTNERSHIP

Core Activities – What We Do



Facilitate CHP Project

- **Identification**
- **Development**
- **Implementation**
- **Recognition**

CHP
EPA COMBINED HEAT AND POWER PARTNERSHIP

Saving Time and Money When Considering CHP

- Needs Assessment:
  - CHP as site-specific solution to economic & technical needs of the owner
  - Procurement approach/ investment criteria
- Importance of the educated Champion:
  - Development process is a series of go or no decisions by investor/ owner/ site
  - Who are the decision makers and what do they need to know?

CHP
EPA COMBINED HEAT AND POWER PARTNERSHIP

The Project Development Process

- Qualification – identify opportunities
- Level 1 Feasibility Analysis – define project goals, identify external deal killers, preliminary economics
- Level 2 Feasibility Analysis – finalize system design to ~30%, final pricing and economics
- Procurement – contract negotiation, utility and regulatory permitting, engineering and construction
- Operation and Maintenance - fuel purchase, ongoing maintenance and service

CHP
EPA COMBINED HEAT AND POWER PARTNERSHIP

Qualification: Spark Spread

- Spark spread is the difference between the price of fuel and electricity – drives CHP economics.
- A CHP system running on $9.00 gas can produce power for ~$.055/ kWh, including the value of free heat.
- Do you currently pay more than $.055/ kWh average including generation, transmission & distribution?
- Other CHP benefits provide economic opportunities which may overcome weak spark spread.

CHP
EPA COMBINED HEAT AND POWER PARTNERSHIP

Qualification: Reliability/ Security

- CHP can be configured to run in the event of a utility outage.
- The added cost and complexity should be justified by the value of risk avoidance.
  - Can add 10 - 30% to total project cost depending on facility electrical design.
- Is there a significant financial or other impact if your facility goes down for 1 hour? For 5 minutes?

CHP
EPA COMBINED HEAT AND POWER PARTNERSHIP

Qualification: Offsetting Equipment Costs

- Designing and installing CHP during new construction or central plant retrofit to saves money.
- CHP can replace other capital equipment
  - Boilers
  - Chillers
  - Backup generators
- Are you planning a new construction, retrofit or equipment replacement project within the next 3-5 years?

CHP
EPA COMBINED HEAT AND POWER PARTNERSHIP

Level 1 Analysis: Identify Barriers

Barriers – uncontrollable externalities

- *Corporate power purchase agreements which require 100% subscription
- *Utility or regulatory policies which prevent or hamper on-site power

If externalities prevent CHP, halt efforts until these change.

If externalities hamper CHP, budget costs of overcoming them into Level 1 analysis.

CHP
EPA COMBINED HEAT AND POWER PARTNERSHIP

Level 1 Analysis: Conceptual Engineering

- Goal: to determine preliminary equipment type and system size, configuration and operation
- Discuss planned changes to site loads or operations
- Electrical and thermal load profiles
  - kW and Mmbtu
  - Usage over time (8760 hours)
  - Readily available historical data, utility bills and anecdotal information

Preliminary CHP System Design

- Fully base-loaded size (kW)
- Prime mover type – turbine, engine, micro-turbine, boiler, fuel cell, etc
- Fuel availability and pressure
- Operating hours at full or part loads
- Thermal application(s) and equipment
- Configured for reliability?
- Location of system, tie-ins, major structural changes to facility
- Operation and maintenance costs

CHP
EPA COMBINED HEAT AND POWER PARTNERSHIP

Preliminary Capital Cost

- Realistic turnkey pricing ranges:
  - Under 2 MW: $1,600 – $3,000/ kW
  - 2-10 MW: $1,100 – $2,500/ kW
  - Over 10 MW: $ 700 - $1,500 / kW

  - Wide range in prices due to varying system designs, project complexity, ease of installation and thermal application.

CHP
EPA COMBINED HEAT AND POWER PARTNERSHIP

Importance of Rate Analysis

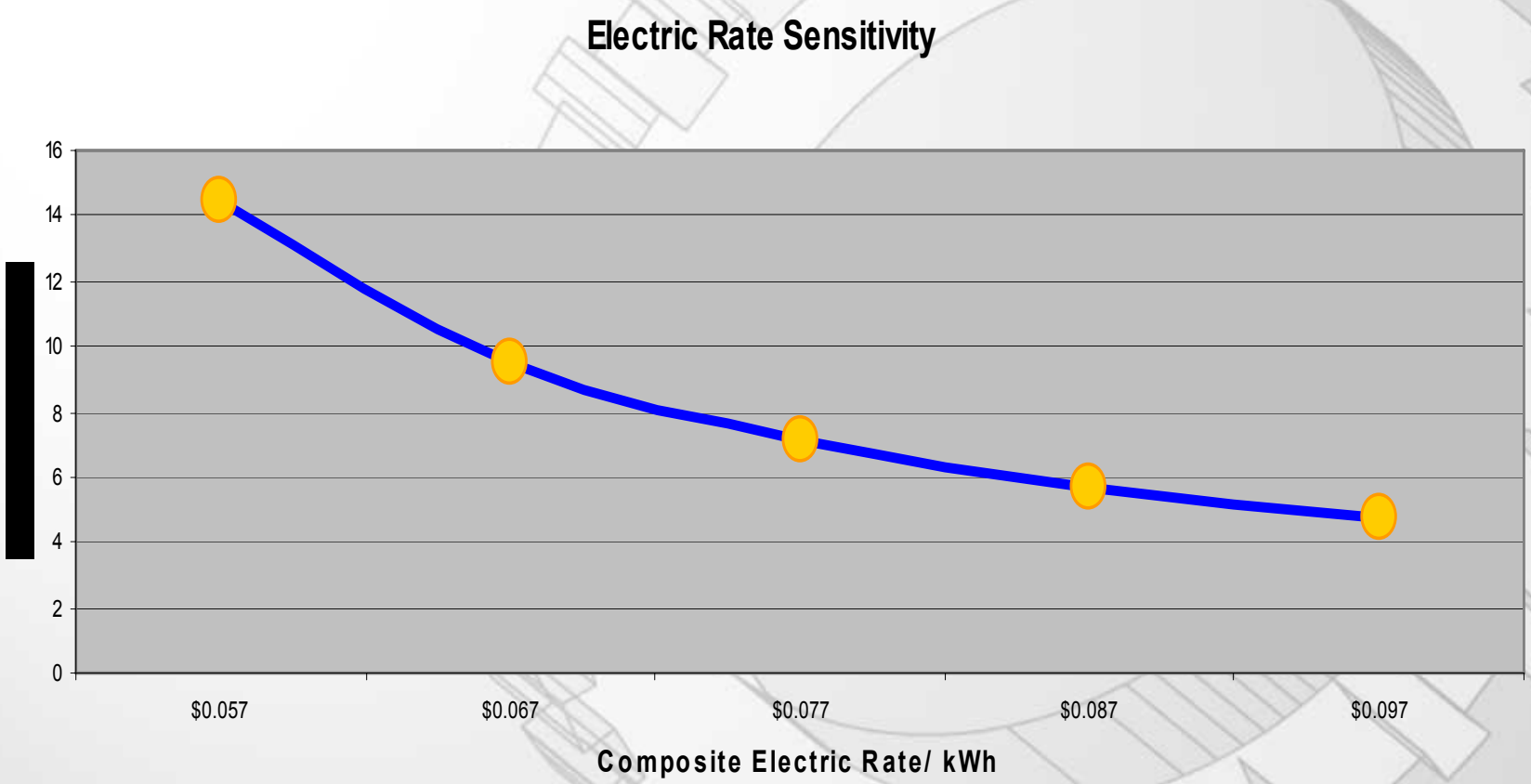
- Both existing and projected post-CHP electric & gas rates should be researched and documented.
- Single largest impact on economics.
- Include any standby or exit fees and CHP/ DG gas rates if applicable.

Sensitivity Analysis

- Important to capture impacts of assumptions/ risks
  - Fuel cost and electricity prices
  - Possible incentives or grants
  - Possible rate disincentives
    - Standby rates
    - Exit fees
    - Interconnection cost overruns

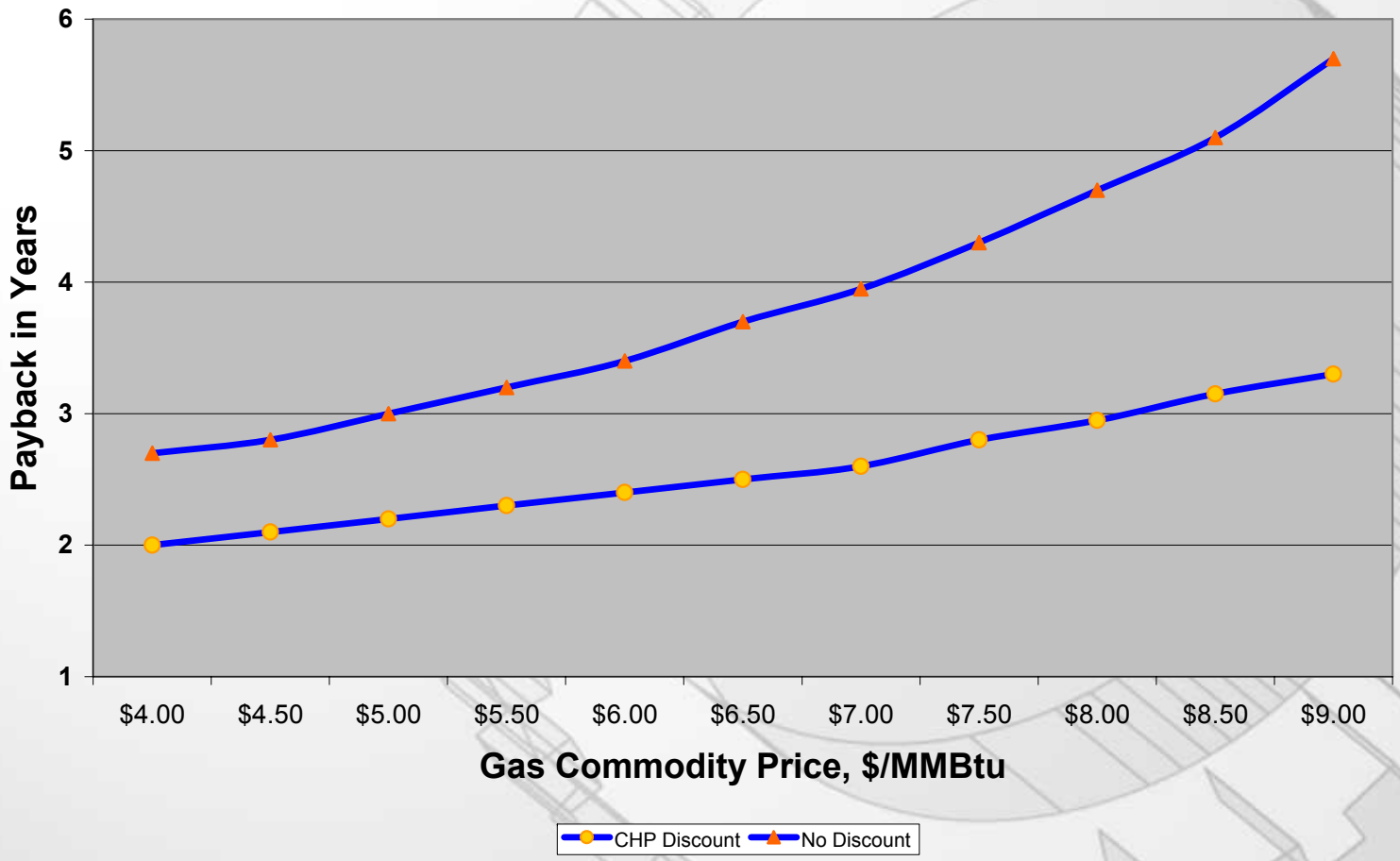
EPA CHP COMBINED HEAT AND POWER PARTNERSHIP

Electric Rate Cost Sensitivity Analysis



CHP
EPA COMBINED HEAT AND POWER PARTNERSHIP

Sensitivity of Payback to Favorable Gas Price – ConEd/ Keyspan



CHP
EPA COMBINED HEAT AND POWER PARTNERSHIP

Level 2 Analysis: the Solution

- Goal is to replace all assumptions in Level 1 analysis with verified data.
- All project/ organization goals should be identified prior to this stage.
- All information for investment decision should be provided by this analysis.
- Level of effort should go to ~ 30% design to ensure system pricing is accurate.

Procurement Approaches

- Construction
  - Design/ bid/ build
  - Turnkey
- Financing – risk/ reward balance
  - Owner capitalization
  - Leasing
  - 3rd Party Build/ Own/ Operate
  - Hybrid risk models

EPA CHP COMBINED HEAT AND POWER PARTNERSHIP

Procurement

- Contract negotiation may include
  - Permitting responsibility
  - Application for grants and incentives
  - Power purchase agreements
  - Commissioning
  - Monitoring & control
  - Service & maintenance
  - Fuel purchase
  - Schedule and cost

Public Recognition

- Energy Star CHP Award and Certificate of Recognition program
  - Recognizes highly efficient projects
- EPA CHP Partner Annual Climate Report
  - Quantifies environmental benefits of projects
  - Provided to Partners who report CHP projects

EPA CHP COMBINED HEAT AND POWER PARTNERSHIP

For More Information

Contact:

Kim Crossman
Combined Heat and Power Partnership
U.S. Environmental Protection Agency
crossman.kim@epa.gov
ph.: (202) 343-9388
fax: (202) 343-2208

http://www.epa.gov/chp

CHP
EPA COMBINED HEAT AND POWER PARTNERSHIP